



VARIATIONS IN POSTERIOR SEGMENT OF CIRCLE OF WILLIS IN HUMAN CADAVERS.

Anatomy

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ABSTRACT

AIMS AND OBJECTIVE : The blood supply of brain is of great importance because of the metabolic demands of the nervous tissue. A significant anastomosis, the Circle of Willis exist between the carotid and vertebral arterial systems. An understanding of the distribution of the arteries is very important. As the neurological signs depends on the site of lesion.

Material and methods: The study was conducted on 45 adult brain specimens of both sexes in human cadavers. The collected specimens were preserved in 10% formalin. The Circle of Willis of each brain was dissected with care.

Results: Variations in posterior segment of Circle of Willis in brain specimens includes – hypoplasia and absence of arteries.

Conclusion: The posterior part of the circle is more anomalous than anterior part and the posterior communicating artery is the most anomalous segment when compared to all the segments of the arterial circle. Various diseases of arteries of brain like cerebro – vascular attack, aneurysm, haemorrhage etc. are related to the anatomic patterns of the Circle of Willis. The knowledge of which is of considerable help to neurosurgeons.

KEYWORDS

ACA, PCA, PCoA, Basilar artery.

INTRODUCTION

The brain gets a copious arterial supply from a pair of internal carotid and a pair of vertebral arteries. Both arterial systems form a polygonal anastomosis, the Circle of Willis, at the base of the brain around the interpeduncular fossa. The internal carotid arteries supply the frontal, parietal and part of the temporal lobes, and the vertebral arteries through the basilar artery and its terminal branches supply the occipital and part of temporal lobes, together with the brain stem and the cerebellum.¹

The arterial circle is formed by the internal carotid artery which is interconnected by the anterior cerebral arteries (ACA) on both the sides and an anterior communicating artery (ACoA) which connect the right and the left anterior cerebral arteries. The carotid system is connected to the posterior cerebral arteries (PCA) of the vertebral system by two posterior communicating arteries (PCoA).

The Circle of Willis equalizes the blood flow to the different parts of the brain and under normal condition little interchange of blood takes place across the anastomotic channel due to equality of the blood pressure. The streams of blood conveyed by the carotid and vertebral systems meet in the posterior communicating artery at a 'dead point' where the pressure of the two is equal and no admixture of blood occurs. However, in case of occlusion of one of the arterial systems, the blood crosses the middle line through the communicating branches and maintains nutrition of the opposite brain by contralateral flow. Therefore, the Circle of Willis acts as principal collateral channel to preserve the independent cerebral blood flow when normal, or dependent blood flow in occlusion of one of the main arterial feeders.

Material and methods

The present study was conducted on 45 adult brain specimens of both sexes in human cadavers. The specimens were collected from cadavers given for dissection in dissection hall of Department of Anatomy and autopsies done in the department of forensic medicine. The collected specimens were preserved in 10% formalin. The Circle of Willis of each brain was dissected out with care. The detailed study of segments of the arterial circle was done in each specimen and the findings were noted. Variations observed in relation to the presence or absence of the differences in each segment of the circle.

The arterial circle was coloured with premium gloss enamel red colour paint by using a '0' number brush. Photographs were taken.

RESULTS AND OBSERVATIONS

The pre-communicating part of posterior cerebral artery (P1 Segment) was present in 39 specimens (86.67%). It was found absent in 6 specimens; out of which, 4 on the right and 2 on the left side.

PCoA Segment :

PCoA Segment		No. of specimens	Percentage
Present		39	86.67%
Absent		6	13.33%
1. Both		—	—
2. PCoA _R		4	8.88%
3. PCoA _L		2	4.44%
Hypoplasia	1. Both	6	13.33%
	2. PCoA _R	9	20%
	3. PCoA _L	3	6.67%

In the present study, the PCoA artery was found to be absent in 6 cases (13.33%), out of which 4 on right side and 2 on left side, which accounted to 8.88% and 4.44% respectively.

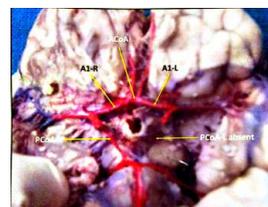
It was observed that the artery was hypoplastic on both sides in 6 cases, on the right side in 9 cases, on the left side in 3 cases.

Basilar Artery:

In the present study the terminal bifurcation of the basilar artery was found to be equal in 39 cases (86.67%), unequal in 6 cases (13.33%). Out of the 6 unequally bifurcating basilar artery, it was found that the artery continued as left PCA in 2 cases (4.44%) and right PCA in 4 cases (8.88%)



BILATERAL PCoA ABSENCE



PCoA-LABSENCE

DISCUSSION:

The Circle of Willis and its branches are subjected to numerous morphological variations has been universally accepted. The findings of the present study were compared with the previous workers as

follows:

Windle (1887) studied 200 brain specimens, the PCA was found to be normal in 173 cases. The commonest variation in relation to PCA was its derivation from one or the other or both from the internal carotid artery instead of the basilar artery. He found absence of PCoA on one or both the sides. The vessel was found to be absent on the right side in 9 cases, on the left side in 13 while it was absent on both the sides in 3 cases.

Fawcett and Blackford (1905) in a study of 700 specimens observed the asymmetry due to abnormal origin of PCA. The right PCA arose from the corresponding internal carotid in 6 cases out of 700. The left PCA arose from the corresponding internal carotid in 4 cases.

Vare and Bansal (1970) conducted a study on the Circle of Willis in 175 brain specimens and they found that the commonest anomaly was the origin of the PCA from the internal carotid artery which was observed in 44 cases, 24 cases on right side, 10 cases on left side and in 10 cases both posterior cerebral arteries arose from internal carotid arteries. They observed complete absence of PCoA in 18 cases, 12 on the left side and 6 on the right side.

PN Jain et. al. (1990), in a study on 144 human brains observed that the total number of specimens showing anomalies were 115 (80.55%). Anterior and posterior parts of the Circle showed anomalies in 42 (29.16%) and 74 (51.38%) cases respectively. The PCoA showed maximum anomalies in 50% of the cases.

Stephen P Lownie and John (1991) explained the variations of Circle of Willis and noted that normal types were observed in only 50% of cases, in 23% of the cases the PCoA was missing on one side, in 14% of the cases, the PCA was arising from the internal carotid with the P1 segment being hypoplastic on the same side.

Michael LJ et. al. (1993) stated that the relative size of the PCoA and the P1 segment are roughly inversely related. When the PCA originates from the ICA, the P1 segment is generally hypoplastic. Conversely when the PCA arises from the basilar artery, the PCoA is hypoplastic.

Don F Schomer et. al. (1994), conducted a study on the arterial anatomy of PCoA in ipsilateral watershed infarctions in 32 cases using MRI and 3D contrast MRI angiograms. They stated that the presence of PCoA measuring at least 1mm in diameter was associated with the absence of watershed infarction.

Macchi et. al. (1996), in a study on the Circle of Willis by Magnetic Resonance Angiography in 100 healthy subjects observed hypoplasia of PCoAs in 21% of cases while in 13% the PCAs were arising from the internal carotid artery.

Anne Osborn (1999) observed that variations in majority of the cases are present in the posterior part of the circle. PCoA was the most common site for variations like absence and hypoplasia.

CONCLUSION:

The posterior part of the circle is found to be more anomalous than anterior part and the posterior communicating artery is the most anomalous segment when compared to all the segments of the arterial circle. The study of variations of the Circle of Willis is very important to understand and pinpoint the location of the lesion of various diseases of brain. Its knowledge is very useful to neurosurgeons who perform different vascular surgeries of brain. So the present study is a small effort to throw a beam of light to the morphology of Circulus Arteriosus.

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